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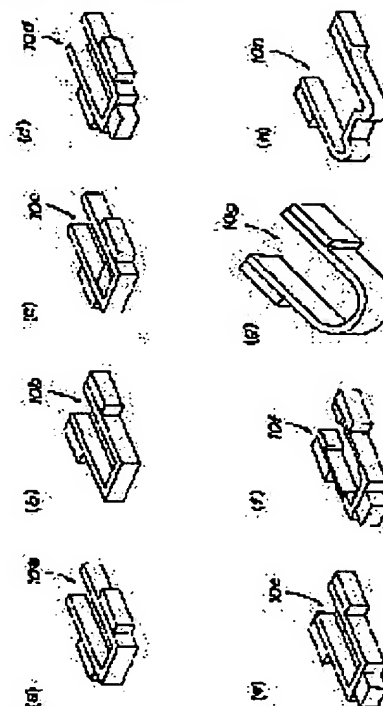
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## (54) PIEZOELECTRIC/ELECTROSTRICTIVE DEVICE AND ITS MANUFACTURING METHOD

(57)Abstract:

**PROBLEM TO BE SOLVED:** To constitute a piezoelectric/electrostrictive device comprising a base 11 having a pair of opposed movable units 11a, 11b, and a coupling part 11c for coupling the units 11a, 11b to each other at one end sides, and piezoelectric/ electrostrictive elements 12a, 12b arranged at side faces of the units 11a, 11b of the base 11 in a simple structure having the small number of components.

**SOLUTION:** The base 11 is formed integrally in a lateral U shape or a U shape by curving one band-like flat plate. The movable units 11a, 11b are extended in a predetermined length from each end of a coupling part 11c to other end side, and the other ends of the units 11a and 11b are disposed at mounting sites if a component to be controlled or a component to be inspected.



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**CLAIMS**


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**[Claim(s)]**

[Claim 1] The base which has the connection section which connects mutually the moving part and both [ these ] the moving part of the pair which carries out phase opposite, and which is mutually arranged in parallel at an end section side, They are the piezo-electricity / electrostriction device which comes to provide the piezo-electricity / electrostriction component arranged in one [ in this base / at least ] lateral surface of said both moving part. They are the piezo-electricity / electrostriction device which said base consists of band-like plates of one sheet in one, and is characterized by said each moving part having extended from each edge of said connection section to the predetermined die-length other end side.

[Claim 2] They are the piezo-electricity / electrostriction device characterized by said piezo-electricity / electrostriction component being shorter than said moving part in piezo-electricity / electrostriction device according to claim 1, and being located in the other end side of this moving part.

[Claim 3] They are the piezo-electricity / electrostriction device characterized by said piezo-electricity / electrostriction component being shorter than said moving part in piezo-electricity / electrostriction device according to claim 1, and being located in the end section side of this moving part.

[Claim 4] They are the piezo-electricity / electrostriction device characterized by presenting the shape of an abbreviation KO character which carries out opening of said base to the other end side of said both moving part in piezo-electricity / electrostriction device according to claim 1.

[Claim 5] They are the piezo-electricity / electrostriction device characterized by said base equipping the inside [ of said connection section ], or external surface side with the monotonous section in piezo-electricity / electrostriction device according to claim 4.

[Claim 6] They are the piezo-electricity / electrostriction device characterized by presenting the letter of the abbreviation for U characters which carries out opening of said base to the other end side of said both moving part in piezo-electricity / electrostriction device according to claim 1.

[Claim 7] The piezo-electricity / electrostriction device characterized by forming in a radii-like hollow the connection part between each edge of each moving part which constitutes said base, and the connection section in piezo-electricity / electrostriction device according to claim 1.

[Claim 8] The piezo-electricity / electrostriction device characterized by forming the pars intermedia of the longitudinal direction in each moving part of said base in the shape of thin meat in piezo-electricity / electrostriction device given in claims 1, 2, 3, 4, 5, 6, or 7.

[Claim 9] They are the piezo-electricity / electrostriction device characterized by said base consisting of metal plates in piezo-electricity / electrostriction device given in claims 1, 2, 3, 4, 5, 6, or 8.

[Claim 10] Piezo-electricity / electrostriction device given in claims 1, 2, 3, 4, 5, 6, 7, 8, or 9 are the piezo-electricity / electrostriction device characterized by taking the use gestalt which pinched the components made into the object of control or inspection in the inside side of the other end of said both moving part that constitutes said base.

[Claim 11] It is the approach of manufacturing the base which constitutes the piezo-electricity / electrostriction device of a publication in claims 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10. The possible plate of crookedness processing by flexibility is adopted as a formation ingredient of said base. The manufacture approach of the base which constitutes the piezo-electricity / electrostriction device which cuts this plate on the plate of a configuration with which said base was developed by the plane, considers as a narrow width-like negative, and is characterized by crooking the predetermined part of this negative and said both moving part and said connection section forming said base of one.

[Claim 12] It is the approach of manufacturing the piezo-electricity / electrostriction device of a publication to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10. As a formation ingredient of said base By adopting the possible plate of crookedness processing by flexibility, cutting this plate on the plate of a configuration with which said base was developed by the

plane, considering as a narrow width-like negative, and crooking the predetermined part of this negative The manufacture approach of of the piezo-electricity / electrostriction device characterized by forming said base of one, and for said both moving part and said connection section sticking piezo-electricity / electrostriction component on one [ at least ] lateral surface of both the moving part that constitutes this base, and forming piezo-electricity / electrostriction device.

[Claim 13] It is the approach of manufacturing the piezo-electricity / electrostriction device of a publication to claims 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10. As a formation ingredient of said base The plate which piezo-electricity / electrostriction component has pasted up is adopted as the possible monotonous predetermined part of crookedness processing by flexibility. By cutting this plate in the configuration in which said base was developed by said piezo-electricity / electrostriction component, and one at the plane, considering as a narrow width-like negative, and crooking the predetermined part of this negative The manufacture approach of of the piezo-electricity / electrostriction device characterized by said both moving part and said connection section forming the piezo-electricity / electrostriction device with which piezo-electricity / electrostriction component is stuck on one [ said base of one, and / at least ] lateral surface of said both moving part.

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**DETAILED DESCRIPTION****[Detailed Description of the Invention]**

**[0001]**

**[Field of the Invention]** This invention relates to the manufacture approach of of the base which constitutes piezo-electricity / electrostriction device, and the said piezo-electricity / electrostriction device, and the said piezo-electricity / electrostriction device.

**[0002]**

**[Description of the Prior Art]** As one format of piezo-electricity / electrostriction device, there are piezo-electricity / an electrostriction device of the format of coming to provide the piezo-electricity / electrostriction component which it comes to arrange in one [ at least ] lateral surface of said both moving part of the base which has the connection section which connects mutually the moving part and both [ these ] the moving part of the pair which carries out phase opposite, and which is mutually arranged in parallel at an end section side, and this base as indicated by the European Patent (EP 1017116A2) specification.

**[0003]** The piezo-electricity / electrostriction device of the format concerned have the actuation function of the moving part resulting from displacement actuation of piezo-electricity / electrostriction component, or the detection function in which piezo-electricity / electrostriction component detects the variation rate of moving part inputted from a detected side, and is used for the large application like the following, using these functions effectively.

**[0004]** That is, the piezo-electricity / electrostriction device of the format concerned are used for the various actuators used for the variation rate of various precision components, such as various sensor components, such as active elements, such as various transducers, various actuators, a frequency-domain functional article (filter), a transformer, an object for a communication link, the trembler for power and a resonator, a radiator, and a discriminator, an ultrasonic sensor, an acceleration sensor, an angular-velocity sensor, an impact sensor, and a mass sensor, an optical instrument and a precision mechanical equipment, etc., or the device of positioning adjustment and include-angle adjustment

**[0005]** By the way, generally the piezo-electricity / electrostriction device of the format concerned consisted of a base, and at least one piezo-electricity / electrostriction component, and these are mutually pasted up through adhesives. Moreover, the base consisted of a configuration member which connects the configuration member which constitutes the moving part of a pair, and both [ these ] the configuration member, and these configuration members of each other are pasted up through adhesives.

**[0006]**

**[Problem(s) to be Solved by the Invention]** Thus, there are many mark of the member of the configuration member, assembly operation is troublesome [ device ] while the piezo-electricity / electrostriction device of the format concerned have high cost, and since it has pasted up each configuration members through adhesives, variation arises in adhesion of each configuration members, and it has a possibility of affecting a device property.

**[0007]** Moreover, it is polluted by organic components, such as dust generated at the time of cutting, cutting fluid, adhesives further used in order to hold device original recording at the time of cutting, and a wax, and washing of piezo-electricity / electrostriction device is not easy for the piezo-electricity / electrostriction device cut and formed from the means which cuts device original recording suitably and picks a large number being taken in order to manufacture the piezo-electricity / electrostriction device of the format concerned.

**[0008]** Moreover, since the ceramics tends to break when it constitutes a base from ceramics, i.e., the baking object of the ceramic grain sheet layered product of two or more sheets, even when it is necessary to adopt the ceramics of the hard quality of the materials, such as a zirconia, and the ceramics of a hard ingredient is adopted, it is necessary to select suitable cutting conditions so that neither a deficit nor a crack may occur. Moreover, in order to be hard to process a base from being the ceramics of a hard ingredient and to increase the processing number of processing, it is necessary to

consider using many processing equipments of a different function etc.

[0009] In addition, although it is also possible to constitute a base from a metallic material, a metallic material must add another process which removes these, in order that an end face may oxidize with frictional heat during cutting or weld flash may remain to a processing end face. Moreover, inspection of piezo-electricity / electrostriction component cannot be carried out, if it is not after cutting device original recording.

[0010] Moreover, although it is desirable to adopt ultrasonic cleaning as washing of the device which it comes to start from device original recording so that dirt can remove easily, when a powerful supersonic wave is used in order to mention a cleaning effect in ultrasonic cleaning, a damage may be given to a device, and piezo-electricity / electrostriction component may exfoliate from a base, or may be damaged. For this reason, although it is necessary to select the weak supersonic wave which does not give a damage to a device to adopt ultrasonic cleaning, when adopting such washing conditions, long duration will be required for removing the dirt which adheres at the time of cutting.

[0011] When the raising dust of it is carried out while driving the raising dust from piezo-electricity / electrostriction device, when using piezo-electricity / electrostriction device as an actuator of the magnetic head of a hard disk drive, the dust becomes a surfacing slider and the cause of crash of media, and it has a possibility of destroying data. Moreover, there is a possibility of the dust adhering to the electrode of piezo-electricity / electrostriction component, and causing short-circuit also to the piezo-electricity / the electrostriction device itself. For this reason, as opposed to a hard disk drive, whenever [ high defecation ] is required of the device itself.

[0012] Therefore, the purpose of this invention is by making the base which constitutes the piezo-electricity / electrostriction device of the format concerned into the integral construction which uses the plate of one sheet as a negative to solve each above-mentioned problem.

[0013]

[Means for Solving the Problem] This invention makes applicable to application the piezo-electricity / electrostriction device of the format of coming to provide the piezo-electricity / electrostriction component arranged in one [ at least ] lateral surface of said both moving part of the base which has the connection section which connects mutually the moving part and both [ these ] the moving part of the pair which carries out phase opposite, and which is mutually arranged in parallel at an end section side, and this base, about piezo-electricity / electrostriction device.

[0014] A deer is carried out, the piezo-electricity / electrostriction device concerning this invention are constituted in [ said base which constitutes the piezo-electricity / electrostriction device of the above-mentioned format / in the band-like plate of one sheet ] one, and said each moving part is characterized by having extended from each edge of said connection section to the predetermined die-length other end side.

[0015] In the piezo-electricity / the electrostriction disk concerned, said base can be constituted from a metal plate, and the piezo-electricity / the electrostriction device concerned can take the use gestalt which pinched the components made into the object of control or inspection in the inside side of the other end of said both moving part that constitutes said base.

[0016] In the piezo-electricity / electrostriction device concerning this invention, said piezo-electricity / electrostriction component can take the configuration located in the end section side of this moving part while being able to take the configuration which is shorter than said moving part and is located in the other end side of this moving part.

[0017] In the piezo-electricity / electrostriction device concerning this invention, it can consider as the configuration which presents the shape of an abbreviation KO character which carries out opening of said base to the other end side of said both moving part. In this case, it can consider as the configuration which prepares the monotonous section in said base at an inside [ of said connection section ], or external surface side. Moreover, in the piezo-electricity / electrostriction device concerning this invention, the configuration which presents the letter of the abbreviation for U characters which carries out opening of said base to the other end side of said both moving part, and the configuration which the connection part between each edge of each moving part and the connection section forms in a radii-like hollow can be taken. In the piezo-electricity / electrostriction device concerning this invention, the configuration which forms the pars intermedia of the longitudinal direction in each moving part of said base in the shape of thin meat can be taken further again.

[0018] Moreover, this invention is the approach of manufacturing the base which constitutes the piezo-electricity / electrostriction device concerning this invention. The possible plate of crookedness processing by flexibility is adopted as a formation ingredient of said base. This plate is cut on the plate of a configuration with which said base was developed by the plane, and it considers as a narrow width-like negative, and is characterized by crooking the predetermined part of this negative and said both moving part and said connection section forming said base of one.

[0019] This invention is the approach of manufacturing the piezo-electricity / electrostriction device concerning this invention. Moreover, as a formation ingredient of said base By adopting the possible plate of crookedness processing by

flexibility, cutting this plate on the plate of a configuration with which said base was developed by the plane, considering as a narrow width-like negative, and crooking the predetermined part of this negative It is characterized by forming said base of one, and for said both moving part and said connection section sticking piezo-electricity / electrostriction component on one [ at least ] lateral surface of both the moving part that constitutes this base, and forming piezo-electricity / electrostriction device. Other manufacture approaches of manufacturing the piezo-electricity / electrostriction device concerning this invention further again As a formation ingredient of said base, the possible plate of crookedness processing by flexibility which it is monotonous and piezo-electricity / electrostriction component has pasted up on the predetermined part is adopted. By cutting this plate in the configuration in which said base was developed by said piezo-electricity / electrostriction component, and one at the plane, considering as a narrow width-like negative, and crooking the predetermined part of this negative Said both moving part and said connection section are characterized by forming the piezo-electricity / electrostriction device with which piezo-electricity / electrostriction component is stuck on one [ said base of one, and / at least ] lateral surface of said both moving part.

[0020]

[Function and Effect of the Invention] In the piezo-electricity / electrostriction device concerning this invention The base which constitutes piezo-electricity / electrostriction device is the thing of the integral construction which consisted of band-like plates of one sheet. Since the base consists of one configuration member in principle, a configuration member can reduce the number of erectors of a configuration member, and can mitigate cost sharply while it becomes a base and two kinds such as piezo-electricity / electrostriction component and can reduce sharply the configuration member of piezo-electricity / electrostriction device.

[0021] Moreover, in the piezo-electricity / electrostriction device concerning this invention, since there are very few mark of the member of a configuration member and there are also in jointing of each configuration members, the variation in adhesion of each configuration members has a nil or device property with a high precision which is not almost and was set up. [ very few ]

[0022] Thus, although effective piezo-electricity / electrostriction device can be manufactured easily and cheaply by each above-mentioned manufacture approach concerning this invention Especially about the base which constitutes the piezo-electricity / electrostriction device concerning this invention Adopt the possible plate of crookedness processing by flexibility as the formation ingredient, and said base cuts this plate in the configuration developed by the plane, and uses it as a narrow width-like negative. By taking the manufacture approach that the predetermined part of this negative is crooked and both moving part and said connection section form the base of one, it can manufacture easily and cheaply.

[0023]

[Embodiment of the Invention] The base which has the connection section which connects mutually the moving part and both [ these ] the moving part of the pair in which this invention carries out phase opposite, and which is mutually arranged in parallel at an end section side, It is the piezo-electricity / electrostriction device which comes to provide the piezo-electricity / electrostriction component arranged in one [ in this base / at least ] lateral surface of both moving part, and with the band-like plate of one sheet, it is crooked the shape of a KO character, and in the shape of U character in one, and the base is formed. Drawing 1 shows typically many operation gestalten (operation gestalt [ of \*\* a 1st ] - 8th operation gestalt) of the piezo-electricity / electrostriction device concerning this invention.

[0024] the 1- shown in (a) - (f) of drawing 1 -- each 6th operation gestalt The 7th operation gestalt which bases are the piezo-electricity / electrostriction device which presents the shape of a KO character, and is shown in (g) of this drawing It is the piezo-electricity / electrostriction device with which a base presents the shape of U character, and the 8th operation gestalt shown in (h) of this drawing is the piezo-electricity / electrostriction device with which the base is presenting the shape of a KO character, and the connection part between each edge of each moving part and the connection section is formed in the radii-like hollow.

[0025] The 1st piezo-electricity / electrostriction device 10a which is the 1st operation gestalt, and the 2nd piezo-electricity / electrostriction device 10b which is the 2nd operation gestalt have the fundamental configuration of the piezo-electricity / electrostriction device concerning this invention, and the 1st piezo-electricity / electrostriction device 10a is formed by the approach shown in drawing 2 and drawing 3 , and the 2nd piezo-electricity / electrostriction device 10b is formed by the approach shown in drawing 4 .

[0026] The 1st piezo-electricity / electrostriction device 10a consists of piezo-electricity / electrostriction components 12a and 12b of a base 11 and a pair, as shown in drawing 3 (c). A base 11 With the narrow width, it is crooked in the shape of a KO character, the long negative is formed, and it consists of connection section 11c which connects mutually the moving part 11a and 11b and both the moving part 11a and 11b of a right-and-left pair in an end section side. In the base 11 concerned, it has pasted up through the adhesives with which each piezo-electricity / electrostriction



components 12a and 12b become the lateral surface of each moving part 11a and 11b from an epoxy resin etc. [0027] It is the multilayer object which consists of piezo-electricity / an electrostriction layer, and an electrode layer, and each moving part 11a and 11b is the same configurations, it is short formed in predetermined length, connection section 11c was approached and pasted in the end section side in each moving part 11a and 11b, and each piezo-electricity / electrostriction components 12a and 12b are prolonged in predetermined length to the other end side of each moving part 11a and 11b.

[0028] In the 1st piezo-electricity / electrostriction device 10a, the magnetic head for hard disks (slider) which is the control-section-ed article which is not illustrated, for example is used for it between both moving-part 11a and 11b, arranging in connection section 11c of a base 11 the actuator which is not illustrated, and being arranged.

[0029] A deer is carried out, negative 11A shown in drawing 3 (b) is adopted as a negative for constituting the base 11 which constitutes the 1st piezo-electricity / electrostriction device 10a, and this negative 11A is formed by the approach shown in drawing 2 (a), (b), and drawing 3 (a). Negative 11A shown in drawing 3 (b) is formed in the 1st piezo-electricity / electrostriction device 10a shown in drawing 3 (c) by performing crookedness processing in accordance with the two-dot chain line shown in this drawing.

[0030] Although the configuration member of negative 11A is the plate 11A1 shown in drawing 2 (a) and (b) fundamentally, the piezo-electricity / electrostriction component negatives 12A and 12B of the long picture of two sheets used as each piezo-electricity / electrostriction components 12a and 12b have pasted up. The plate 11A1 which both piezo-electricity / electrostriction component negatives 12A and 12B have pasted up is cut by many parts along with the dashed line shown in drawing 3 (a), and a line parallel to this, and, thereby, much negative 11A shown in this drawing (b) is formed. In accordance with the two-dot chain line shown in this drawing (b), crookedness processing is performed to negative 11A, and the 1st piezo-electricity / electrostriction device 10a shown in this drawing (c) are formed.

[0031] A plate 11A1 is flexibility and it is desirable that Young's modulus is the metal plate of 100 or more GPas. As an iron system ingredient applicable to this, steel materials, such as martensitic stainless steel of the ferritic stainless steel of the austenitic stainless steel of SUS301, SUS304, AISI653, and SUH660 grade, SUS430, and SUS434 grade, SUS410, and SUS630 grade, SUS6312, semi austenitic stainless steel of AISI632 grade, ERUMAJINGUSU ten loess steel, and various spring steel, can be mentioned. Moreover, as a non-iron system ingredient, superelastic titanium alloys, such as a titanium-nickel alloy, brass, cupronickel, aluminum, a tungsten, molybdenum, beryllium copper, phosphor bronze, nickel, a ferronickel alloy, titanium, etc. can be mentioned.

[0032] In addition, in case a base is constituted from a metallic material, it is desirable that the part corresponding to moving part of a base adopts at least the metal plate by which cold rolling processing is carried out.

[0033] Although a deer is carried out and the 1st piezo-electricity / electrostriction device 10a functions as the piezo-electricity / electrostriction device of this conventional seed format similarly, since a base 11 is the thing of the integral construction which uses negative 11A as a configuration member, the operation effectiveness like the following is done so.

[0034] That is, the 1st piezo-electricity / electrostriction device 10a uses as a configuration member the base 11 of the integral construction which consists only of negative 11A, and a configuration member can reduce the number of erectors of a configuration member sharply, and can mitigate cost sharply while it becomes a base 11 and two kinds such as piezo-electricity / electrostriction component (12a, 12b) and can reduce sharply the configuration member of piezo-electricity / electrostriction device 10a.

[0035] Moreover, in the 1st piezo-electricity / electrostriction device 10a, since there are very few mark of a configuration member and there are also in jointing of each configuration members, the variation in adhesion of each configuration members has a nil or device property with a high precision which is not almost and was set up. [ very few ]

[0036] Moreover, it sets to the 1st piezo-electricity / electrostriction device 10a. Into the formation ingredient (plate 11A1) of negative 11A which is the configuration member of a base 11 Since the configuration which forms negative 11A by pasting up beforehand piezo-electricity / electrostriction component negatives 12A and 12B, and cutting a plate 11A1 to piezo-electricity / electrostriction component negatives 12A and 12B, and one is adopted, While the activity which pastes up piezo-electricity / electrostriction components 12a and 12b on each moving part 11a and 11b which is very thin and small parts can be canceled and assembly is easy at the time of the assembly of piezo-electricity / electrostriction device The adhesion precision to each moving part 11a and 11b of piezo-electricity / electrostriction components 12a and 12b can be raised further.

[0037] The 2nd piezo-electricity / electrostriction device 10b which is the 2nd operation gestalt shown in drawing 1 (b) have other fundamental configurations of the piezo-electricity / electrostriction device concerning this invention, and is

formed by the approach shown in drawing 4 .

[0038] As the 2nd piezo-electricity / electrostriction device 10b is shown in drawing 4 (c), it consists of piezo-electricity / electrostriction components 12a and 12b of a base 13 and a pair, and although it is the same as that of the 1st piezo-electricity / electrostriction device 10a, at this point, only the arrangement location of each piezo-electricity / electrostriction components 12a and 12b is different [ as for the 1st piezo-electricity / electrostriction device 10a ]. In the 2nd piezo-electricity / electrostriction device 10b, the other end side in each moving part 13a and 13b was pasted, and each piezo-electricity / electrostriction components 12a and 12b are prolonged in predetermined length to the end section, i.e., connection section 13c of base 13, side of each moving part 11a and 11b.

[0039] A deer is carried out, negative 13A shown in drawing 4 (b) is adopted as a negative for constituting the base 13 which constitutes the 2nd piezo-electricity / electrostriction device 10b, and this negative 13A is formed by cutting the plate 13A1 shown in this drawing (a) along with a dashed line. Piezo-electricity / electrostriction component negatives 12A and 12B have pasted the edge section before and behind that, even if a plate 13A1 meets the cutting plane line of a large number parallel not only to two dashed lines but these dashed lines which are not illustrated, it is cut by the plate 13A1, and much negative 13A is started.

[0040] Crookedness processing is carried out in accordance with the two-dot chain line shown in drawing 4 (b), and negative 13A is formed in the 2nd piezo-electricity / electrostriction device 10b shown in this drawing (c). The 2nd piezo-electricity / electrostriction device 10b is the points that both piezo-electricity / electrostriction components 12a and 12b are located in the other end side of both the moving part 13a and 13b, and although the 1st piezo-electricity / electrostriction device 10a differs in a configuration, it is the same configuration in respect of others. Therefore, the 2nd piezo-electricity / electrostriction device 10b does the same operation effectiveness so while having the 1st piezo-electricity / electrostriction device 10a, and a similar function.

[0041] The 3rd and 4th piezo-electricity / electrostriction devices 10c and 10d which are the 3rd operation gestalt and the 4th operation gestalt which are shown in drawing 1 (c) and (d) Considering the 1st piezo-electricity / electrostriction device 10a as a basic configuration, the 5th and 6th piezo-electricity / electrostriction devices 10e and 10f which are the 5th operation gestalt and the 6th operation gestalt which are shown in this drawing (e) and (f) consider the 2nd piezo-electricity / electrostriction device 10b as a basic configuration.

[0042] As the 3rd piezo-electricity / electrostriction device 10c shown in drawing 1 (c) are shown in drawing 5 (c), it consists of piezo-electricity / electrostriction components 12a and 12b of a base 14 and a pair, and at this point, although it is the same as that of the 1st piezo-electricity / electrostriction device 10a, it is the point that 14d of monotonous sections is prepared in connection section 14c which constitutes a base 14, and the 1st piezo-electricity / electrostriction device 10a is different. 14d of monotonous sections is located in the inside side of connection section 14c within between both moving-part 14a and 14b. They function that the adhesion area to the actuator in the case of using connection section 14c as supporters, such as an actuator, etc. should be expanded while 14d of monotonous sections functions that connection section 14c should be reinforced.

[0043] A deer is carried out, negative 14A shown in drawing 5 (b) is adopted as a negative for constituting the base 14 of the 3rd piezo-electricity / electrostriction device 10c, and this negative 14A is formed by cutting the plate 14A1 shown in this drawing (a) along with a dashed line. While piezo-electricity / electrostriction component negatives 12A and 12B have pasted two places of the pars intermedia before and behind the front face, plate-like member 14D which forms 14d of monotonous sections in the center section before and behind the rear face has pasted the plate 14A1. A plate 14A1 is cut along with the cutting plane line which is arranged in parallel in the dashed line and these which show in this drawing (a) and which is not illustrated, and much negative 14A is started.

[0044] Crookedness processing is carried out in accordance with the two-dot chain line shown in drawing 5 (b), and negative 14A is formed in the 3rd piezo-electricity / electrostriction device 10c shown in this drawing (c). The 3rd piezo-electricity / electrostriction device 10c is points equipped with 14d of monotonous sections, and although the 1st piezo-electricity / electrostriction device 10a differs in a configuration, it is the same configuration in respect of others. Therefore, although the 3rd piezo-electricity / electrostriction device 10c does the same operation effectiveness so while having the same function as the 1st piezo-electricity / electrostriction device 10a, it originates in 14d of monotonous sections, and has the function reinforced to connection section 14c, and the function to expand adhesion area.

[0045] The 4th piezo-electricity / electrostriction device 10d shown in drawing 1 (d), as shown in drawing 6 (c), it consists of piezo-electricity / electrostriction components 12a and 12b of a base 15 and a pair, and although it is the same as that of the 1st piezo-electricity / electrostriction device 10a in this point, it is the point that 15d of monotonous sections is prepared in connection section 15c which constitutes a base 15, and the 1st piezo-electricity / electrostriction device 10a is different. 15d of monotonous sections is located in the external surface side of connection section 15c it is the opposite side between [ whose ] both moving-part 15a and 15b. 15d of monotonous sections functions that the



adhesion area to the actuator in the case of using connection section 15c as supporters, such as an actuator, etc. should be expanded.

[0046] A deer is carried out, negative 15A shown in drawing 6 (b) is adopted as a negative for constituting a base (the 4th piezo-electricity / electrostriction device 10d) 15, and this negative 15A is formed by cutting the plate 15A1 shown in this drawing (a) along with a dashed line. While piezo-electricity / electrostriction component negatives 12A and 12B have pasted two places of the pars intermedia before and behind the front face, plate-like member 15D which forms 15d of monotonous sections in the center section before and behind the front face has pasted the plate 15A1. A plate 15A1 is cut along with the cutting plane line which is arranged in parallel in the dashed line and these which show in this drawing (a) and which is not illustrated, and much negative 15A is started.

[0047] Crookedness processing is carried out in accordance with the two-dot chain line shown in drawing 6 (b), and negative 15A is formed in the 4th piezo-electricity / electrostriction device 10d shown in this drawing (c). The 4th piezo-electricity / electrostriction device 10d is points equipped with 15d of monotonous sections, and although the 1st piezo-electricity / electrostriction device 10a differs in a configuration, it is the same configuration in respect of others. Therefore, the 4th piezo-electricity / electrostriction device 10d, although the same operation effectiveness is done so while having the same function as the 1st piezo-electricity / electrostriction device 10a, it originates in 15d of monotonous sections, and the function to expand adhesion area to connection section 15c is demonstrated.

[0048] The 5th piezo-electricity / electrostriction device 10e shown in drawing 1 (e) Although it consists of piezo-electricity / electrostriction components 12a and 12b of a base 16 and a pair and is the same as that of the 2nd piezo-electricity / electrostriction device 10b in this point as the 2nd piezo-electricity / electrostriction device 10b shown in this drawing (b) are considered as a basic configuration and it is shown in drawing 7 (c) In that 16d of monotonous sections is prepared in connection section 16c which constitutes a base 16, it is different from the 2nd piezo-electricity / electrostriction device 10b. 16d of monotonous sections is located in the external surface side of connection section 16c of the opposite side with between both moving-part 16a and 16b. 16d of monotonous sections functions that the adhesion area to the actuator in the case of using connection section 16c as supporters, such as an actuator, etc. should be expanded.

[0049] A deer is carried out, negative 16A shown in drawing 7 (b) is adopted as a negative for constituting the base 16 of the 5th piezo-electricity / electrostriction device 10e, and this negative 16A is formed by cutting the plate 16A1 shown in this drawing (a) along with a dashed line. While piezo-electricity / electrostriction component negatives 12A and 12B have pasted two places of the edge before and behind the front face, plate-like member 16D which forms 16d of monotonous sections in the center section before and behind the front face has pasted the plate 16A1. A plate 16A1 is cut along with the cutting plane line which is arranged in parallel in the dashed line and these which show in this drawing (a) and which is not illustrated, and much negative 16A is started.

[0050] Crookedness processing is carried out in accordance with the two-dot chain line shown in drawing 7 (b), and negative 16A is formed in the 5th piezo-electricity / electrostriction device 10e shown in this drawing (c). The 5th piezo-electricity / electrostriction device 10e is the points that 16d of monotonous sections is formed, and although the 2nd piezo-electricity / electrostriction device 10b differs in a configuration, it is the same configuration in respect of others. Therefore, although the 5th piezo-electricity / electrostriction device 10e does the same operation effectiveness so while having the same function as the 2nd piezo-electricity / electrostriction device 10b, it originates in 16d of monotonous sections, and demonstrates the function to expand adhesion area to connection section 16c.

[0051] The 6th piezo-electricity / electrostriction device 10f shown in drawing 1 (f) It is what considers the 2nd piezo-electricity / electrostriction device 10b shown in this drawing (b) as a basic configuration. As shown in drawing 8 (c), in the point that 17d of monotonous sections is prepared in connection section 17c which consists of piezo-electricity / electrostriction components 12a and 12b of a base 17 and a pair, and constitutes a base 17, it is the same configuration as the 5th piezo-electricity / electrostriction device 10e. However, the 6th piezo-electricity / electrostriction device 10f, the pars intermedia of the longitudinal direction of both the moving part 17a and 17b is formed in a thin-walled part 17a1 and 17b1 covering predetermined die length, and is different from the 5th piezo-electricity / electrostriction device 10e in this point. The thin-walled part 17a1 of both the moving part 17a and 17b and 17b1 function so that they may raise the amount of displacement of both the moving part 17a and 17b.

[0052] A deer is carried out, negative 17A shown in drawing 8 (b) is adopted as a negative for constituting a base (the 6th piezo-electricity / electrostriction device 10f) 17, and this negative 17A is formed by cutting the plate 17A1 shown in this drawing (a) along with a dashed line. While piezo-electricity / electrostriction component negatives 12A and 12B have pasted two places of the edge before and behind the front face, plate-like member 17D which forms 17d of monotonous sections in the center section before and behind the front face has pasted the plate 17A1.

[0053] Moreover, in the plate 17A1, two parts of the pars intermedia in the cross direction are formed in a thin-walled

part 17a1 and 17b1 covering predetermined die length. A plate 17A1 is cut along with the cutting plane line which is arranged in parallel in the dashed line and these which show in this drawing (a) and which is not illustrated, and much negative 17A is started.

[0054] Crookedness processing is carried out in accordance with the two-dot chain line shown in drawing 8 (b), and negative 17A is formed in the 6th piezo-electricity / electrostriction device 10f shown in this drawing (c). In the point that each moving part 17a and 17b has a thin-walled part 17a1 and 17b2 the 6th piezo-electricity / electrostriction device 10f, although the 5th piezo-electricity / electrostriction device 10e differs in a configuration, it is the same configuration in other points. Therefore, the 6th piezo-electricity / electrostriction device 10f, although the same operation effectiveness is done so while having the same function as the 5th piezo-electricity / electrostriction device 10e, it originates in a thin-walled part 17a1 and 17b1, and the function which increases the amount of displacement of each moving part 17a and 17b is demonstrated.

[0055] In addition, a plate 17A1 and the plate pierced and processed while being able to adopt and form means, such as etching, laser beam machining, an electron discharge method, ion milling, sandblasting, and drilling, about the thin-walled part 17a1 of each moving part 17a and 17b in a base 17 and 17b1 can be prepared too much, and it can form by making this rival to the part to which a substrate corresponds.

[0056] The 1st piezo-electricity / electrostriction device 10a, and the 2nd piezo-electricity / electrostriction device 10b the 7th piezo-electricity / electrostriction device 10g, and whose 8th piezo-electricity / electrostriction device 10h that is the 7th and 8th operation gestalt shown in drawing 1 (g) and (h) are the 1st and 2nd operation gestalt differs in a format.

[0057] Consisting of piezo-electricity / electrostriction components 12a and 12b of a base 18 and a pair, as shown in drawing 9 (c) the 7th piezo-electricity / electrostriction device 10g which is the 7th operation gestalt, in the point that connection section 18c which constitutes a base 18 is presenting the shape of radii, the 2nd piezo-electricity / electrostriction device 10b is different. Radii-like connection section 18c functions so that it may aim at increase of the amount of displacement of both the moving part 18a and 18b, and smooth displacement actuation.

[0058] A deer is carried out, negative 18A shown in drawing 9 (b) is adopted as a negative for constituting a base (the 7th piezo-electricity / electrostriction device 10g) 18, and this negative 18A is formed by cutting the plate 18A1 shown in this drawing (a) along with a dashed line. Piezo-electricity / electrostriction component negatives 12A and 12B have pasted two places of the edge before and behind the front face, a plate 18A1 is cut by the plate 18A1 along with the cutting plane line which is arranged in parallel in the dashed line and these which show in this drawing (a) and which is not illustrated, and much negative 18A is started.

[0059] Crookedness processing is carried out in accordance with the two-dot chain line shown in drawing 9 (b), and negative 18A is formed in the 7th piezo-electricity / electrostriction device 10g shown in this drawing (c). In the point that connection section 18c which connects both the moving part 18a and 18b the 7th piezo-electricity / electrostriction device 10g is presenting the shape of radii, although the 2nd piezo-electricity / electrostriction device 10b differs in a configuration, it is the same configuration in other points. Therefore, the 7th piezo-electricity / electrostriction device 10g, while having the same function as the 2nd piezo-electricity / electrostriction device 10b, the same operation effectiveness is done so, but it originates in radii-like connection section 18c, and it functions in order to aim at increase of the amount of displacement of both the moving part 18a and 18b, and smooth displacement actuation.

[0060] The 8th piezo-electricity / electrostriction device 10h shown in drawing 1 (h) As shown in drawing 10 (c), it consists of piezo-electricity / electrostriction components 12a and 12b of a base 19 and a pair. In the connection part 19c1 which connects each moving part 19a and 19b and connection section 19c which constitute a base 19, and the point that 19c2 is formed in the radii-like hollow, the 2nd piezo-electricity / electrostriction device 10b is different. The connection part 19c1 of a circular hollow and 19c2 function so that they may aim at increase of the amount of displacement of both the moving part 19a and 19b, and smooth displacement actuation.

[0061] A deer is carried out, negative 19A shown in drawing 10 (b) is adopted as a negative for constituting a base (the 8th piezo-electricity / electrostriction device 10h) 19, and this negative 19A is formed by cutting the plate 19A1 shown in this drawing (a) along with a dashed line. As for the plate 19A1, two parts of the pars intermedia before and behind that are formed in the shape of a wave. These wave-like parts 19c3 and 19c4 form the connection part 19c1 and 19c2, when it corresponds to the connection part 19c1 and 19c2 and crookedness processing of the negative 19A is carried out. Piezo-electricity / electrostriction component negatives 12A and 12B have pasted the plate 19A1 at two places of the edge before and behind the front face. A plate 19A1 is cut along with the cutting plane line which is arranged in parallel in the dashed line and these which show in this drawing (a) and which is not illustrated, and much negative 19A is started.

[0062] Crookedness processing is carried out in accordance with the two-dot chain line shown in drawing 10 (b), and negative 19A is formed in the 8th piezo-electricity / electrostriction device 10h shown in this drawing (c). In the

connection part 19c1 which connects both the moving part 19a and 19b with connection section 19c the 8th piezo-electricity / electrostriction device 10h, and the point that 19c2 is formed in the radii-like hollow, although the 2nd piezo-electricity / electrostriction device 10b differs in a configuration, it is the same configuration in other points. Therefore, the 8th piezo-electricity / electrostriction device 10h, while having the same function as the 2nd piezo-electricity / electrostriction device 10b, the same operation effectiveness is done so, but it originates in the connection part 19c1 and 19c2, and it functions in order to aim at increase of the amount of displacement of both the moving part 19a and 19b, and smooth displacement actuation.

[0063] In an approach to manufacture each the above piezo-electricity / electrostriction device, means, such as laser beam machining, such as machining of dicing processing, wire-saw processing, etc., and an YAG laser, excimer laser, and electron beam machining, are employable as a means to cut the plate 11A1 to 19A1 which stuck piezo-electricity / electrostriction component negative.

[0064] The piezo-electricity / electrostriction components 12a and 12b which constitute the piezo-electricity / electrostriction devices 10a-10h concerning each above-mentioned operation gestalt are equipped with the electrode of the pair for impressing electric field to piezo-electricity / electrostriction layer, and this, and are piezo-electricity / electrostriction components, such as a uni-morph mold and a bimorph mold. Also among these piezo-electricity / electrostriction components, the piezo-electricity / electrostriction component of a uni-morph mold are excellent in the stability of the variation rate to derive, and since it is advantageous to lightweight-izing, it is suitable as a component part of piezo-electricity / electrostriction device.

[0065] The piezo-electricity / electrostriction components 21-24 of several examples which are adopted suitably are shown in drawing 11 and drawing 12 as the piezo-electricity / electrostriction components 12a and 12b which constitute piezo-electricity / electrostriction devices 10a-10h.

[0066] The piezo-electricity / electrostriction component 21 shown in drawing 11 (a) are the things of the monolayer structure where there are one piezo-electricity / electrostriction layer, and consists of piezo-electricity / electrostriction layer 21a, the 1st and 2nd electrode 21b and 21c of a pair, and terminals 21d and 21e of a pair. The piezo-electricity / electrostriction component 22 shown in this drawing (b) are the things of the two-layer structure where piezo-electricity / electrostriction layer is two-layer. It consists of 2nd electrode 22c which surrounds 1st electrode 22b which intervenes between piezo-electricity / electrostriction layer 22a (22a1, 22a2), the both piezo-electricity / electrostriction layer 22a1, and 22a2, the both piezo-electricity / electrostriction layer 22a1, and the lateral surface of 22a2, and terminals 22d and 22e of a pair.

[0067] Moreover, the piezo-electricity / electrostriction components 23 and 24 which are shown in drawing 12 are the things of 4 layer structures four piezo-electricity / electrostriction layers are [ layer structures ]. The piezo-electricity / electrostriction component 23 shown in this drawing (a) consist of piezo-electricity / electrostriction layer 23a (23a1 to 23a4), the 1st and 2nd electrode 23b and 23c that intervenes between both these piezo-electricity / electrostriction layers, and is surrounded, and terminals 23d and 23e of a pair.

[0068] Moreover, it consists of the 1st and 2nd electrode 24b and 24c which piezo-electricity / electrostriction component 23 differs in the arrangement part of a terminal, and the piezo-electricity / electrostriction component 24 shown in this drawing (b) intervene between piezo-electricity / electrostriction layer 24a (24a1 to 24a2), and these both piezo-electricity / electrostriction layers, and is surrounded, and terminals 24d and 24e of a pair.

[0069] Each these piezo-electricity / electrostriction components 21-24 are suitably adopted according to the application of piezo-electricity / electrostriction device as the piezo-electricity / electrostriction components 12a and 12b of each piezo-electricity / electrostriction device.

[0070] Although electrostrictive ceramics is used for the piezo-electricity / electrostriction layers 21a-24a which constitute each piezo-electricity / electrostriction components 21-24, it is also possible to use the electrostriction ceramics, strong dielectric ceramics, the antiferroelectric ceramics, etc. However, when using piezo-electricity / electrostriction device for the positioning means of the magnetic head of a hard disk drive etc., since linearity with the amount of displacement, driver voltage, or output voltage in the attachment section of the magnetic head is important, it is desirable to use the small ingredient of distortion hysteresis. It is desirable that a coercive electric field uses an ingredient 10kV [ /mm ] or less.

[0071] Specifically as an ingredient for forming piezo-electricity / electrostriction layers 21a-24a, independence, such as lead zirconate, lead titanate, magnesium niobic acid lead, zinc niobic acid lead, manganese niobic acid lead, antimony stannic-acid lead, a manganese lead wolframate, cobalt niobic acid lead, barium titanate, a titanic-acid sodium bismuth, niobic acid potassium sodium, and a tantalic acid strontium bismuth, or such proper mixture can be mentioned. The ingredient which uses lead zirconate, lead titanate, and magnesium niobic acid lead as a principal component especially, or the ingredient which uses a titanic-acid sodium bismuth as a principal component is suitable.

[0072] A proper ingredient can be added into the ingredient for forming piezo-electricity / electrostriction layers 21a-24a, and the property of piezo-electricity / electrostriction layer can be adjusted to it. As add-in material, the independence of oxides, such as a lanthanum, calcium, strontium, molybdenum, a tungsten, barium, niobium, zinc, nickel, manganese, caesium, cadmium, chromium, cobalt, antimony, iron, an yttrium, a tantalum, a lithium, a bismuth, and tin, or the ingredient which finally serves as an oxide, or such proper mixture can be mentioned.

[0073] For example, there is an advantage which can adjust a coercive electric field and a piezo-electric property by making the lead zirconate which is a principal component, lead titanate, magnesium niobic acid lead, etc. contain a lanthanum and strontium. In addition, addition of ingredients which are easy to vitrify, such as a silica, should be avoided. It is because ingredients which are easy to vitrify, such as a silica, tend to react with piezo-electricity / electrostriction layer at the time of heat treatment of piezo-electricity / electrostriction layer, the presentation is changed and a piezo-electric property is degraded.

[0074] The electrodes 21b, 21c-24b which constitute each piezo-electricity / electrostriction components 21-24, and 24c are solid-states at a room temperature, and it is desirable to be formed with the metallic material excellent in conductivity. As a metallic material, the simple substance of metals, such as aluminum, titanium, chromium, iron, cobalt, nickel, copper, zinc, niobium, molybdenum, a ruthenium, palladium, a rhodium, silver, tin, a tantalum, a tungsten, iridium, platinum, gold, and lead, or the alloy of these metals can be mentioned. Moreover, the cermet ingredient which makes these metallic materials come to distribute the ceramics of the same ingredient as piezo-electricity / electrostriction layer or a different ingredient can also be used.

[0075] Each piezo-electricity / electrostriction components 21-24 are in piezo-electricity / electrostriction layers 21a-24a, each electrodes 21b, 21c-24b, and the condition that carried out the laminating of the 24c mutually, and it is desirable to form by calcinating in one. In this case, it is desirable to adopt as an electrode what consists of refractory metal ingredients, such as platinum, palladium, or these alloys, and the electrode which consists of a cermet ingredient which is the mixture of a refractory metal ingredient, and the formation ingredient of piezo-electricity / electrostriction layer and other ceramic ingredients. As for the thickness of an electrode, it is desirable to have the shape of a thin thin film as much as possible from becoming the factor which affects the variation rate of piezo-electricity / electrostriction component. For this reason, in order for the electrode which is calcinated by piezo-electricity / electrostriction layer, and one, and is formed in them to serve as the shape of a thin thin film as much as possible, as for the ingredient which forms an electrode, it is desirable to use it with the gestalt of a metal paste, for example, a golden resinate paste, a platinum resinate paste, a silver resinate paste, etc.

[0076] The thickness of each piezo-electricity / electrostriction components 21-24 has the desirable range of 40 micrometers - 180 micrometers, when using it as the piezo-electricity / electrostriction components 12a and 12b of the piezo-electricity / electrostriction device of each operation gestalt. The miniaturization of a device becomes difficult when it is easy to damage during handling when thickness is less than 40 micrometers, and thickness exceeds 180 micrometers. Moreover, like piezo-electricity / electrostriction components 23 and 24, by considering as multilayer structure, piezo-electricity / electrostriction component makes the output increase, and can aim at expansion of the variation rate of a device. Moreover, since the rigidity of a device improves by making piezo-electricity / electrostriction component into multilayer structure, the resonance frequency of a device becomes high and there is an advantage which can accelerate displacement actuation of a device.

[0077] Each piezo-electricity / electrostriction components 21-24 are created with the means which cuts down many negatives of the large area which carries out the laminating of piezo-electricity / electrostriction layer, and the electrode by printing or tape forming, and comes to calcinate them in a predetermined dimension by the dicer, the slicer, a wire saw, etc. Since it is thin and the degree of hardness is low as compared with a well-known ceramic base, piezo-electricity / electrostriction components 21-24 can set up the cutting speed of a negative quickly, and can carry out processing processing in large quantities at high speed.

[0078] Each piezo-electricity / electrostriction components 21-24 are simple platy structures, and are easy handling, and there is little coating weight of dirt, and they tend to remove dirt. However, since piezo-electricity / electrostriction components 21-24 make a ceramic ingredient a subject, they need to set up suitable washing conditions in ultrasonic cleaning. In the piezo-electricity / electrostriction component started from the negative, after carrying out precision washing by US washing, it is desirable among atmospheric air to remove completely the moisture which has entered into the detailed pore of a ceramic ingredient, and the organic substance by heat-treating at 100 degrees C - 1000 degrees C.

[0079] If manufacture of each the above piezo-electricity / electrostriction components 21-24 is synthesized, the thin film forming methods, such as the thick-film forming methods, such as screen printing, a dipping method, the applying method, and an electrophoresis method, and the ion beam method, the sputtering method, vacuum evaporation

technique, the ion plating method, a chemical-vapor-deposition method (CVD), the galvanizing method, are employable as manufacture of piezo-electricity / electrostriction component. In order to adopt these manufacture approaches and to form piezo-electricity / electrostriction component, it is the negative of a base or a base, and piezo-electricity / electrostriction component can be directly formed on monotonous, and it forms on a proper support substrate, this is removed, and you may make it stick a base or on monotonous.

[0080] As the piezo-electricity / electrostriction components 12a and 12b which constitute the piezo-electricity / electrostriction devices 10a-10h concerning each operation gestalt When adopting each piezo-electricity / electrostriction components 21-24, as an adhesion means against the base of each piezo-electricity / electrostriction components 21-24 It is desirable to use the adhesives of inorganic systems, such as resin system adhesives, such as an epoxy resin, UV resin, and hot melt adhesive, and glass, cement, solder, low material, and it can also use what mixed metal powder and ceramic powder in resin system adhesives. As for the degree of hardness of adhesives, 80 or more are desirable at Shore D.

[0081] Moreover, as other modes which adopt each piezo-electricity / electrostriction components 21-24, as shown by the piezo-electricity / electrostriction devices [ 10a-10h ] manufacture approach, piezo-electricity / electrostriction component negatives 12A and 12B, and same same piezo-electricity / electrostriction component negative are pasted up monotonously, this plate can be cut to proper width of face, and the mode which is the former plate of a base and which is started to the negative of a base and one can also be taken. Thereby, the piezo-electricity / electrostriction components 21-24 of the configuration shown in drawing 11 or drawing 12 are formed on the negative of a base at one.

[0082] In addition, in the part of the front face which the piezo-electricity / electrostriction component in a base paste up, it is desirable to perform split-face processing of blasting, etching, plating, etc. beforehand. By making surface roughness like jointing into about  $Ra=0.1$ micrometer-5micrometer, adhesion area can be increased and bond strength can be raised. In this case, the one where the front face like jointing by the side of piezo-electricity / electrostriction component is also coarser is desirable. It is made not to arrange an electrode on the front face of the piezo-electricity / electrostriction layer of the lowest layer to flow through an electrode with a base.

[0083] In using solder and low material, in order to improve wettability as adhesives, it is desirable to arrange the electrode layer of a metallic material on the front face of piezo-electricity / electrostriction component. As for the thickness of adhesives, it is desirable that it is the range of 1 micrometer - 50 micrometers. Although the thinner one of the thickness of adhesives is desirable in respect of the point of reducing the variation rate of a device, and dispersion of the resonance characteristic, and space-saving-izing, in order to secure properties, such as bond strength, a variation rate, and resonance, the optimal thickness is set up for every adhesives to adopt.

[0084] Selection in the case of adopting each piezo-electricity / electrostriction components 21-24 as the piezo-electricity / electrostriction devices 10a-10h concerning each operation gestalt is performed based on a piezo-electricity / electrostriction devices [ 10a-10h ] application. With piezo-electricity / electrostriction component with few number of layers of piezo-electricity / electrostriction layer, although power consumption is small, its driving force is also small, and conversely, although power consumption is large, its driving force is also large with piezo-electricity / electrostriction component with many number of layers of piezo-electricity / electrostriction layer. In consideration of these things, the piezo-electricity / electrostriction component suitable for the application of piezo-electricity / electrostriction device are chosen. Generally, the thing of two or more layers has desirable piezo-electricity / electrostriction layer, and the piezo-electricity / electrostriction component of the range of three layers - ten layers can adopt [ piezo-electricity / electrostriction layer ] piezo-electricity / electrostriction component suitably. As for a location gap of the electrode in piezo-electricity / electrostriction component, it is desirable that it is 50 micrometers or less.

[0085]

[Example] Explain configuration [ of piezo-electricity / mentioning as the example of the representation of piezo-electricity / creating piezo-electricity / belonging under the category of the 2 piezo-electricity / that it is the operation gestalt of \*\* two / starting this invention / that this example shows to drawing 1 (b) // electrostriction device 10 b // an electrostriction device, and starting this invention in the piezo-electricity concerned / an electrostriction device // an electrostriction device basing the piezo-electricity concerned / an electrostriction device, and starting this invention // an electrostriction device ], actuation, and operation effectiveness to a detail. The piezo-electricity / the electrostriction device concerned are superficially shown in drawing 13 .

[0086] In piezo-electricity / the electrostriction device 30 concerned, it becomes a base 31 from the piezo-electricity / electrostriction component 32 of a pair, and the piezo-electricity / electrostriction component 24 shown in drawing 12 (b) are adopted as each piezo-electricity / electrostriction component 32. Therefore, it is used in the explanation in the following of each configuration member of piezo-electricity / electrostriction component 32, changing each sign of the base of No. 24 of each configuration member of piezo-electricity / electrostriction component 24 into each sign of the



base of No. 32.

[0087] The base 31 which constitutes piezo-electricity / the electrostriction device 30 concerned presents the shape of a KO character which consists of connection section 31c which has connected mutually the moving part 31a and 31b and both the moving part 31a and 31b of the pair which carries out phase opposite, and which is mutually arranged in parallel in those end sections, and both the moving part 31a and 31b and connection section 31c are formed in one with the band-like plate. Opening of the base 31 is carried out to the other end side of both the moving part 31a and 31b, and it is formed in the attachment part 31a1 for the medial surface by the side of the other end of both the moving part 31a and 31b to attach the components H, such as the magnetic head, and 31b1.

[0088] Each piezo-electricity / electrostriction component 32 were stuck on the lateral surface of the other end in each moving part 31a and 31b, and is prolonged from the other end of each moving part 31a and 31b in predetermined length to the end section side. Moreover, Components H have fixed each edge through adhesives 31a2 and 31b2 to the attachment part 31a1 in each moving part 31a and 31b, and 31b1.

[0089] The dimension like each part of about each part of the base 31 which constitutes piezo-electricity / the electrostriction device 30 concerned, and the piezo-electricity / electrostriction component 32 is set as the optimal dimension relation in consideration of the support reinforcement to components DO H of both the moving part 31a and 31b, the amount of displacement which both the moving part 31a and 31b gives to Components H.

[0090] In piezo-electricity / the electrostriction device 30 concerned, the base 31 is formed by SUS304 of 40 micrometers of board thickness, for example. Moreover, it is the four-layer structure which the piezo-electricity / electrostriction component 24 shown in drawing 12 (b) are being used for piezo-electricity / electrostriction component 32, and used PZT, and the thickness of each class of piezo-electricity / electrostriction layer 32a is 15 micrometers and the thin film with which 3-micrometer platinum and each terminals 32d and 32e consist of a golden paste in each electrodes 32b and 32c. Each piezo-electricity / electrostriction component 32 are pasted up on the lateral surface of each moving part 31a and 31b with the heat-curing epoxy resin adhesive of 1 liquid.

[0091] In the piezo-electricity / the electrostriction device 30 of this configuration concerned, when each attachment section 31a1 in each moving part 31a and 31b at the time of making piezo-electricity / electrostriction component 32 drive by the 1kHz sine wave of driver voltage 20\*\*20V and the variation rate of 31b1 were measured, it was \*\*1.5 micrometers. Moreover, it was 45kHz when the resonance frequency which carries out the sweep of the frequency as sinusoidal-voltage\*\*0.5V, and shows the maximum of a variation rate was measured.

[0092] Next, for explaining based on the piezo-electricity / electrostriction device 30 which described above actuation of the piezo-electricity / electrostriction device concerning this invention, the condition of not operating [ of the piezo-electricity / the electrostriction device 30 concerned ] is shown in drawing 13 , and the operating state of the piezo-electricity / the electrostriction device 30 concerned is shown at drawing 14 .

[0093] In piezo-electricity / the electrostriction device 30 concerned, it is in the condition which shows in drawing 13 at the time of un-operating [ the electrical potential difference is not impressed to each piezo-electricity / electrostriction component 32 to operate ], and the major axis m of piezo-electricity / electrostriction device 30, and each attachment part 31a1 and the medial axis n between 31b1 are mostly in agreement. As it is in this condition, for example, is shown in the wave form chart of drawing 15 (a), the sine wave Wb which has the predetermined bias potential Vb is applied to the electrodes 32b and 32c of the pair in one piezo-electricity / electrostriction component 32, and as shown in this drawing (b), the sine wave Wa from which a phase differs about about 180 degrees is applied to the electrodes 32b and 32c of the pair in the piezo-electricity / electrostriction component 32 of another side in said sine wave Wb.

[0094] Thereby, as opposed to the electrodes 32b and 32c of the pair in one piezo-electricity / electrostriction component 32, the piezo-electricity / electrostriction layer 32a in one piezo-electricity / electrostriction component 32 carry out contraction displacement in the direction of a principal plane in the phase where the electrical potential difference of maximum was impressed. For this reason, in piezo-electricity / the electrostriction device 30 concerned, since the stress which makes it bend rightward [ illustration ] (the direction of arrow-head A) to one moving-part 31a of a base 31 occurs as shown, for example in drawing 14 , moving-part 31a bends in this direction.

[0095] In this case, since the electrodes 32b and 32c of the pair in the piezo-electricity / electrostriction component 32 of another side are in the condition that an electrical potential difference is not impressed, moving-part 31b of another side of a base 31 follows bending of one moving-part 31a, and bends in moving-part 31a and this direction. Consequently, both the moving part 31a and 31b displaces rightward [ illustration ] to the major axis m of piezo-electricity / electrostriction device 30. The amount of displacement of this variation rate changes according to the maximum of applied voltage to each piezo-electricity / electrostriction component 32. The amount of displacement becomes large, so that the maximum of an electrical potential difference becomes large.

[0096] When the piezo-electricity / electrostriction ingredient which has a high coercive electric field as a component of



the piezo-electricity / electrostriction layer 32a which constitutes piezo-electricity / electrostriction component 32 especially are adopted, you may make it adjust said bias potential so that the level of the minimum value may turn into negative level slightly as shown in the wave of the two-dot chain line of (a) of drawing 15 , and (b). In this case, the stress of the bending direction of one moving-part 31a and this direction occurs in moving-part 31b of another side of a base 31, and the drive of the piezo-electricity / electrostriction component 32 to which the bias potential of negative level is impressed, for example, the piezo-electricity / electrostriction component of another side, enables it to enlarge more the attachment part 31a1 and the amount of displacement of 31b1.

[0097] The piezo-electricity / electrostriction component 32 to which the bias potential of negative level is impressed can give the function to support the piezo-electricity / electrostriction component 32 which serves as a subject of displacement actuation, by using the wave shown according to the thing two-dot chain line in (a) and (b) of drawing 15 , if it puts in another way.

[0098] Thus, it sets to piezo-electricity / the electrostriction device 30 concerned. Since the minute variation rate of piezo-electricity / electrostriction component 32 will be amplified by big displacement actuation using bending of both the moving part 31a and 31b of a base 31 and will be transmitted to both the moving part 31a and 31b, The attachment part 31a1 and 31b1 become possible [ carrying out a variation rate greatly to the major axis m of piezo-electricity / electrostriction device 30 ].

[0099] In piezo-electricity / the electrostriction device 30 concerned, in order to demonstrate the function much more certainly, it is desirable to consider the dimension relation like each part of about each part of a base 31, and the piezo-electricity / electrostriction component 32 as following.

[0100] The dimension like each part of the piezo-electricity / the electrostriction device 30 concerned is shown in drawing 13 , among each dimension, L1 is the overall length of piezo-electricity / electrostriction device 30, and is the overall length of a base 31, and L2 is full [ of piezo-electricity / electrostriction device 30 ]. Moreover, L3 is the die length like the non-adhesion part of piezo-electricity / electrostriction component 32, L6 is the die length of piezo-electricity / electrostriction component 32, and L7 is the width of face of piezo-electricity / electrostriction component 32. [ in / full / of a base 31 / , and L4, and / in L5 / moving part 31a and 31b ] [ spacing between both moving-part 31a of a base 31, and 31b ]

[0101] Moreover, the die length with which, as for L8, the substantial drive parts of piezo-electricity / electrostriction component and the fixed part of the component mounting section lap among each dimension, L9 -- for the thickness of moving part, and L11, as for the die length like the moving part of moving part, and L13, the thickness of the connection section and L12 are [ thickness and L10 / the die length of the plane of composition of the attachment section and L14 ] the die length of the substantial mechanical component of piezo-electricity / electrostriction component 32 at adhesives, M1 is the die length of Components H, and M2 is the width of face of Components H.

[0102] In piezo-electricity / the electrostriction device 30 concerned, the relation between the spacing L4 between both moving-part 31a of a base 31 and 31b and the die length M1 of the longitudinal direction of Components H is  $L4 \geq M1$ , and is  $L4 - M1 = 0.001 - 0.01\text{mm}$ . In the case of  $L4 < M1$ , in case Components H are inserted between both moving-part 31a and 31b, it is necessary to extend between both moving-part 31a and 31b, and there is a possibility of damaging a device in this case in it. The thickness L9 of adhesives is  $0.005 - 0.1\text{mm}$ , and is  $0.01 - 0.05\text{mm}$  more preferably. When the thickness L9 of adhesives is thicker than  $0.1\text{mm}$ , it becomes difficult for adhesives to tend to flow out and to put into the thickness of a predetermined dimension.

[0103] When the difference of the spacing L4 between both moving-part 31a of a base 31 and 31b and the die length M1 of the longitudinal direction of Components H is small, impregnation of Components H and the adhesives of a between [ each attachment part 31a1 and 31b1 ] is difficult in inserting Components H in spacing L4, and control of the thickness L9 of adhesives is difficult. In setting up the thickness L9 of adhesives more thinly than  $0.01\text{mm}$ , it is easy to generate dispersion in the bond strength to Components H. For this reason, the thickness L9 of adhesives is  $0.01 - 0.03\text{mm}$  much more preferably.

[0104] The thickness L10 of moving part 31a and 31b is  $0.001 - 0.2\text{mm}$ , and that of a base 31 is  $0.01 - 0.1\text{mm}$  more preferably, and is  $0.03 - 0.08\text{mm}$  much more preferably. The smaller one in the ability to do of full [ of connection section 31c / L2 ] (die length), the die length L12 like the moving part of moving part 31a and 31b, the attachment part 31a1, the thickness L9 of the adhesives of 31b1, and the thickness L10 grade of moving part 31a and 31b is desirable, thereby, full [ of a device / the overall length L1 and full / L2 ] become small, and a device is miniaturized.

[0105] The die length L12 like the moving part of the moving part 31a and 31b in a base 31 is  $0.3 - 2\text{mm}$  preferably  $0.2 - 3\text{mm}$ . The attachment part 31a2 of both the moving part 31a and 31b and the die length L13 of 31b2 are  $0.05 - 2\text{mm}$ . The spacing L4 of both the moving part 31a and 31b is  $0.1 - 2\text{mm}$ , and is  $0.2 - 1.6\text{mm}$  preferably. if it is in this dimension -- (die length L3 of both moving parta [ 31 ] and 31b)/(spacing L4 of both the moving part 31a and 31b) --  $0.5 - 10$  -- it is

0.5-5 preferably. (spacing L4 of both moving parts [ 31 ] and 31b)/(thickness L10 of moving part 31a and 31b) -- 0.5-20 -- desirable -- 1-15 -- it is 1-10 still more preferably.

[0106] piezo-electricity -- /-- electrostriction -- a component -- substantial -- a drive -- a part -- component mounting -- the section -- a fixed part -- lapping -- die length -- L -- eight -- moving part -- 31 -- a -- 31 -- b -- thickness -- L -- ten -- one -- /-- two -- being large -- things -- namely, -- L -- eight --  $> (L10/2)$  -- it is -- things -- being desirable . According to this setup, the driving force of piezo-electricity / electrostriction layer 32a acts efficiently to a variation rate.

[0107] The die length L13 of the plane of composition of the attachment parts 31a and 31b in the moving part 31a and 31b of a base is set as the width of face M2 and abbreviation identities of components H \*\* in the condition which shows in drawing 13 . however, when the die length M1 of Components H is longer than the width of face M2 By making the attachment part 31a2 and the die length L13 of 31b2 into the approach of bending for a long time, the attachment part 31a2 and 31b2 by forming in the attachment part of adhesion convention die length so that device 10f may see The die length L13 of the plane of composition of the attachment parts 31a and 31b is specified as the die length M1 of Components H in independent. Or where Components H are pasted up, from the attachment part 31a2 and 31b2, the point of Components H is made to project, and is made and the thing thing of it can be carried out.

[0108] As for the die length L14 of the substantial mechanical component of piezo-electricity / electrostriction component, it is desirable to carry out to 20 - 95% of the die length L12 like the moving part in moving part 31a and 31b, and it is 40 - 80% more preferably.

[0109] Piezo-electricity / the electrostriction device 30 concerned can be used also as an acceleration sensor while being able to use it as an actuator which controls the magnetic head.

[0110] When using piezo-electricity / the electrostriction device 30 concerned as an actuator which controls the magnetic head, the components H shown in drawing 13 are the magnetic heads, and piezo-electricity / the electrostriction device 30 concerned are fixed to a suspension in connection section 31c of the base 31. A suspension is the susceptor for supporting piezo-electricity / the electrostriction device 30 concerned, and piezo-electricity / the electrostriction device 30 concerned have parts other than the connection section 31c in the condition of having floated from the suspension, in the condition of having been fixed to the suspension.

[0111] Moreover, in using piezo-electricity / the electrostriction device 30 concerned as an acceleration sensor, the components H shown in drawing 13 are spindles, and it pastes up Spindle H on the attachment part 31a1 in both the moving part 31a and 31b of a base 31, and 31b1. Drawing 16 shows the mode which used piezo-electricity / the electrostriction device 30 concerned as acceleration-sensor S, and the condition before assembling as concerned acceleration-sensor S shows drawing 17 .

[0112] In the acceleration-sensor S concerned, Spindles H are adhesives, such as an epoxy resin, are pasted up on the attachment part 31a1 of both the moving part 31a and 31b, and 31b1, and piezo-electricity / the electrostriction device 30 concerned are being fixed to the attachment part s2 of the wiring substrate s1 through adhesives, such as an epoxy resin, in the connection section 31c. Piezo-electricity / the electrostriction device 30 concerned have parts other than that connection section 31c in the condition of having floated from the wiring substrate s1, in the state of this attachment. In addition, although wiring for electrical connection and various kinds of circuits are formed in the wiring substrate s1, illustration is omitted about these.

[0113] In the acceleration-sensor S concerned, if adhesion to the wiring substrate s1 of the piezo-electricity / the electrostriction device 30 concerned can be performed by spot welding etc. and the means of spot welding is taken to adhesion, it can attach firmly [ adhesion area is small and ]. Moreover, about Spindle H, acceleration sensibility can be adjusted by setting up the mass suitably.

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[Translation done.]

\* NOTICES \*

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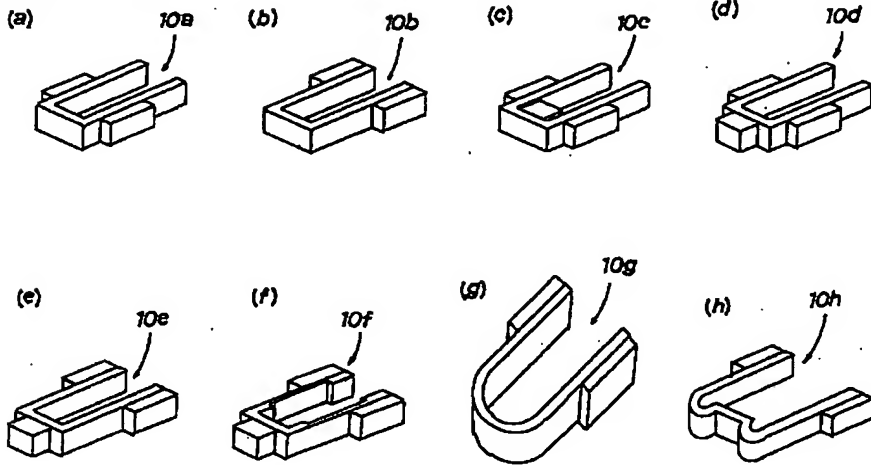
1. This document has been translated by computer. So the translation may not reflect the original precisely.
2. \*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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DRAWINGS

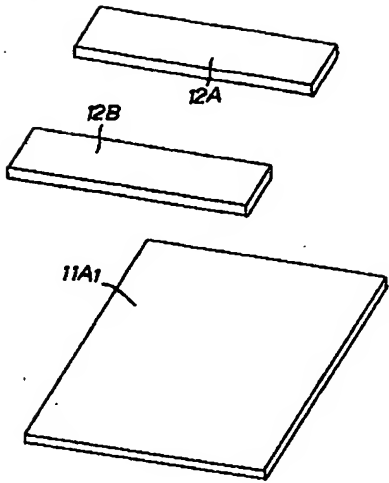
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[Drawing 1]

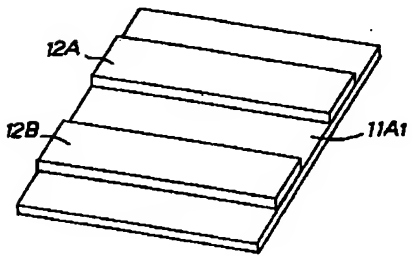


[Drawing 2]

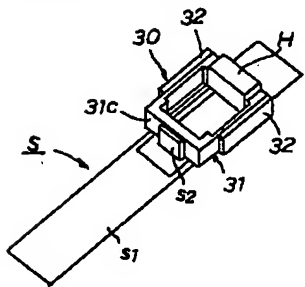
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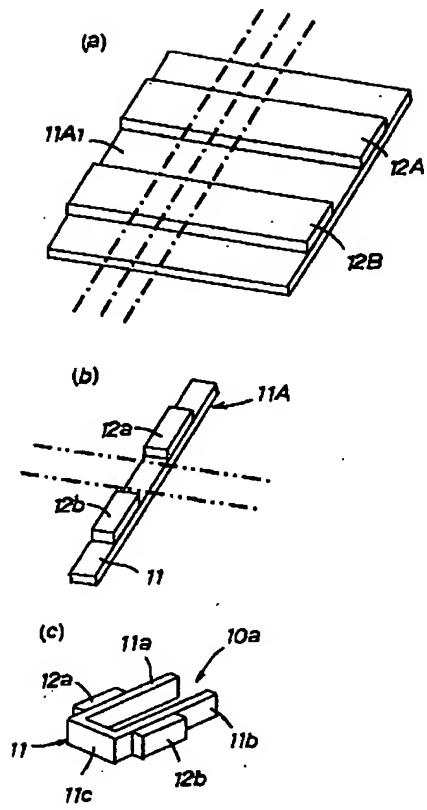
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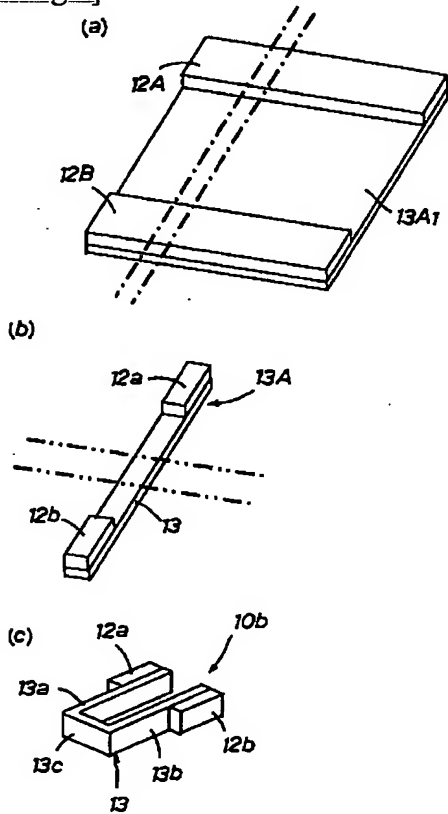
[Drawing 16]



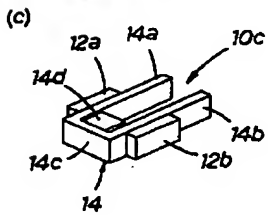
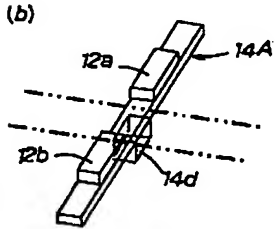
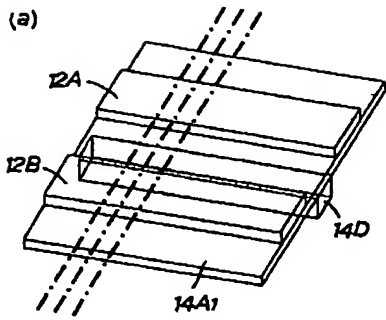
[Drawing 3]



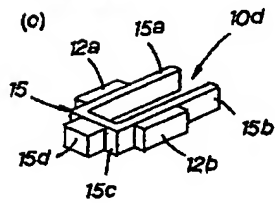
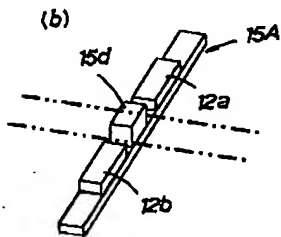
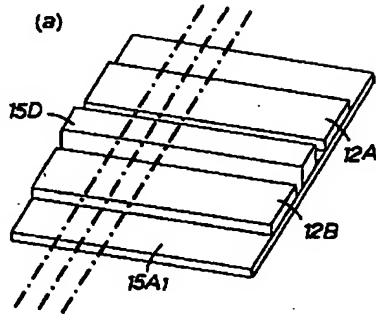
[Drawing 4]



[Drawing 5]

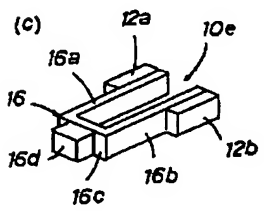
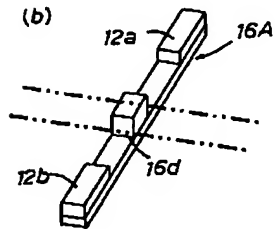
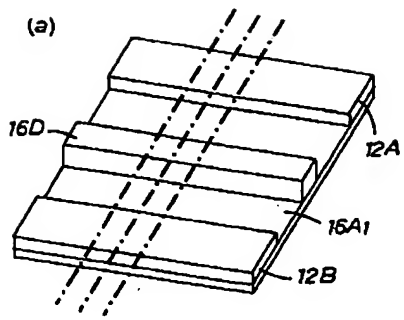


[Drawing 6]

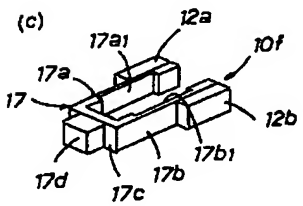
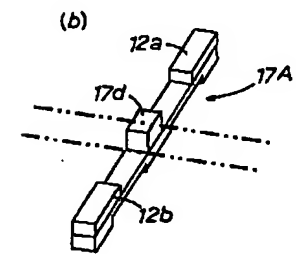
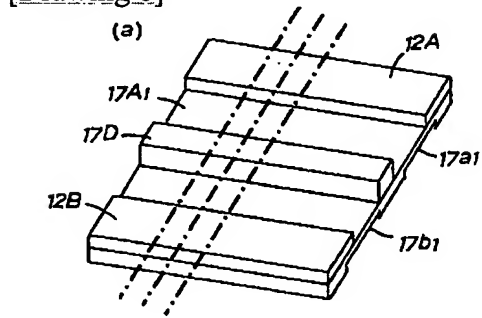


[Drawing 7]

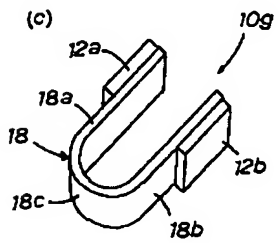
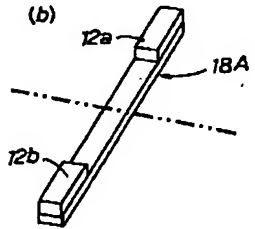
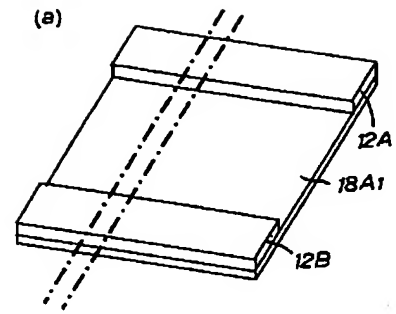




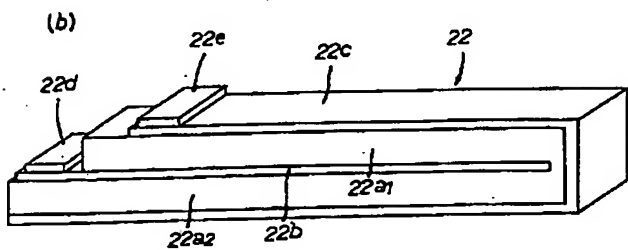
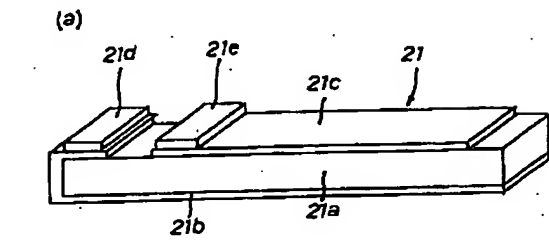
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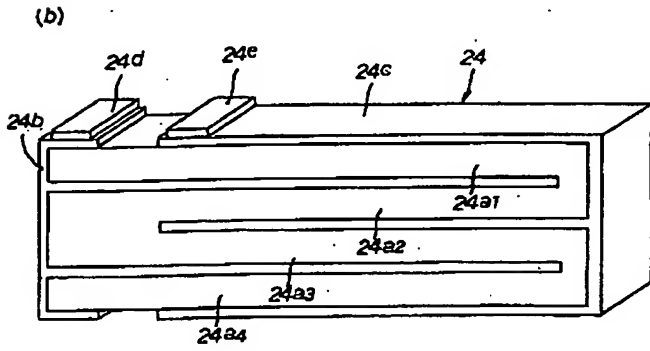
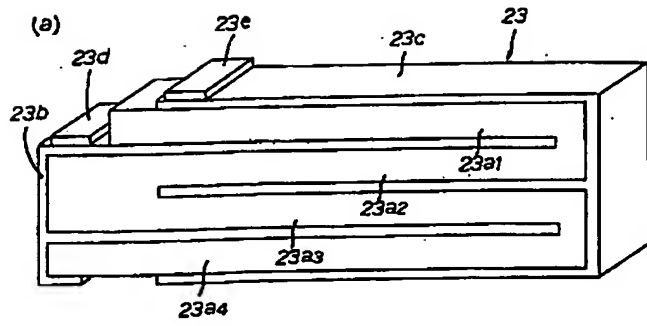
[Drawing 9]



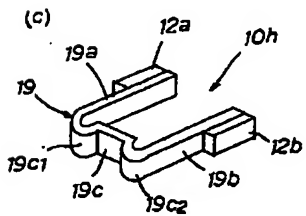
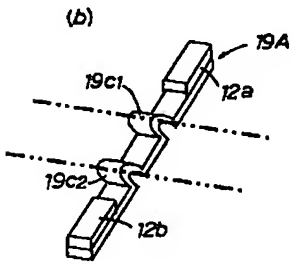
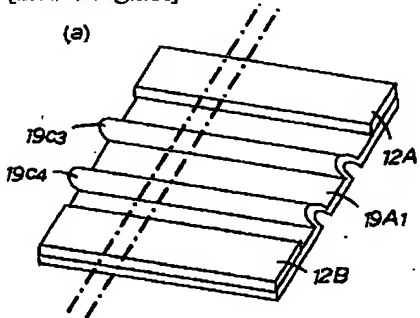
[Drawing 11]



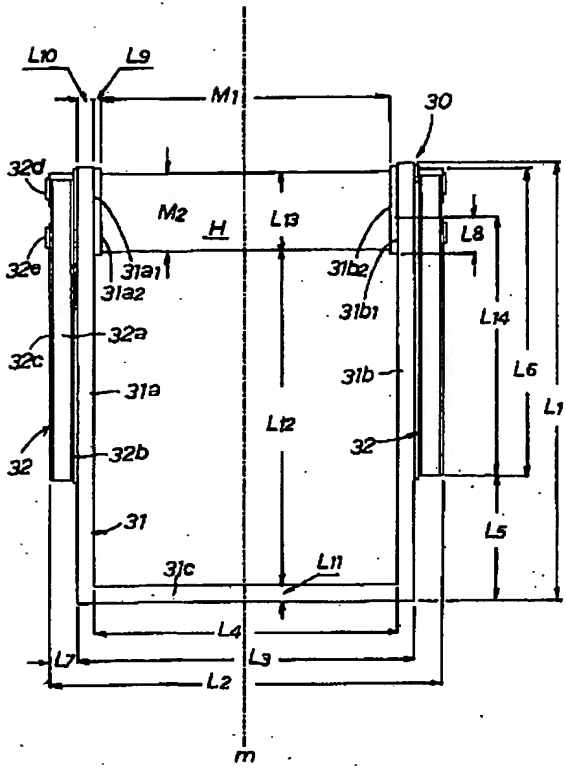
[Drawing 12]



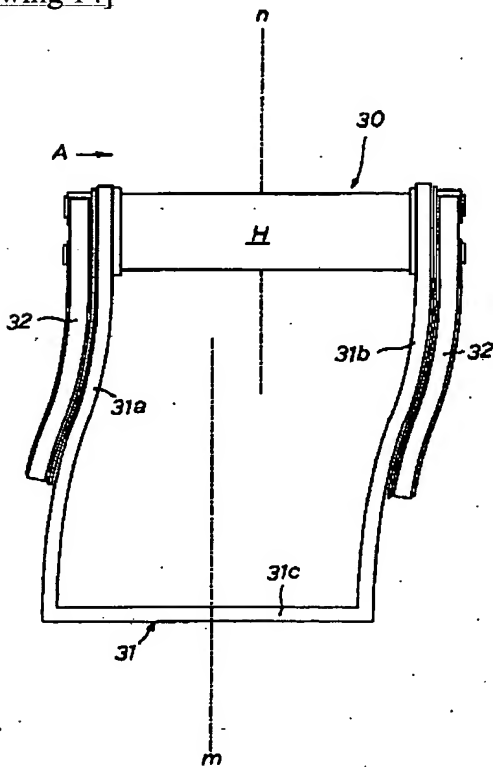
[Drawing 10]



[Drawing 13]

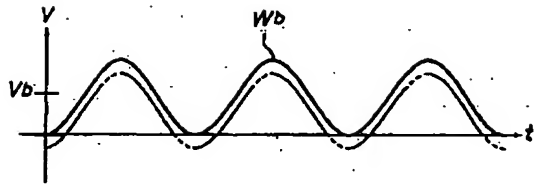


[Drawing 14]

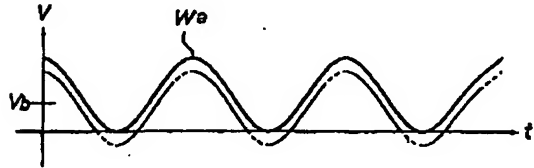


[Drawing 15]

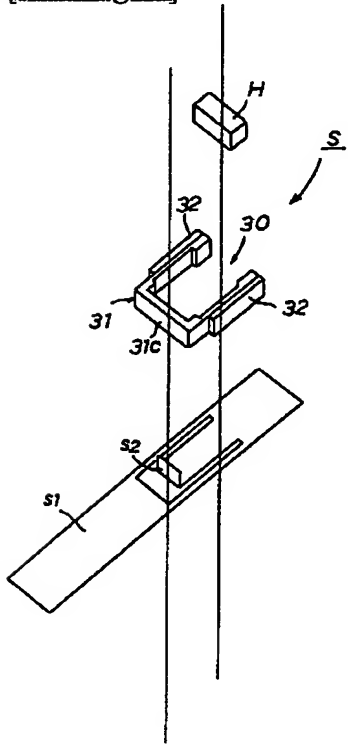
(a)



(b)



[Drawing 17]



[Translation done.]